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SOME PINEAPPLE PROBLEMS.

11th ARTICLE. - THE SCOPE OF THIS WORK.

By Henry C. Henricksen.

THE PRACTICAL PROBLEMS. - In pineapple growing these are how to produce (1) a large per cent of plants that will fruit at an age of 12 to 18 months; (2) large size fruit; (3) fruit of good quality free from blemishes; (4) a large number of slips and suckers; (5) slips and suckers that are potentially capable of reproducing the above mentioned qualities.

In the solution of these problems many factors are involved. Some of them are not readily controlable under field conditions while others may be. The soil factors are basic. They were discussed in the preceding ten articles and strictly speaking it is possible to avoid most of the plant problems by applying the recommendations there given. Yet without some knowledge of what takes place in the plant, remedies cannot be intelligently applied. For that reason the investigations were continued and the results obtained will be described in the following articles.

Some of the outward indications of whether or not a plant is functioning normally were measured. They are: number, size, spininess and color of leaf; size of stalk; root formation; size of fruit/stem and fruit; time of fruiting; number and size of slips. An attempt has been made in the course of this investigation to explain the differences found in the measurements mentioned by means of another set of measurements, as follows: Moisture in tissue; reaction of sap expressed in pH; carbohydrate content and distribution; proteins; enzymes; content of inorganic matter.

Light and temperature factors were not studied exhaustively because of a lack of facilities for doing that kind of work; also because experience has shown that it is impracticable to control these factors under field conditions in Porto Rico. Planters are well aware that growth and fruit maturing proceeds slower during the winter months than in the summer. That is presumably due, principally, to the lower temperature prevailing in winter. This would seem to be the case judging from the behaviour of plants growing in the mountain districts compared with those growing on the costal plains. It is especially noteworthy that fruit maturing is much slower in the mountains than on the costal plains, regardless of the season and the only plausible reason for it seems to be the lower temperature. Also on the costal plains plants grow slower and fruit matures slower during the winter months than in

summer and that is especially so when the rainfall is heavy. Obviously it would be difficult to raise the temperature in the field and actually there is very little reason for doing it, for the loss caused by low temperature is not great.

Regarding light, the problem is how to subdue it rather than to increase it. The pineapple plant thrives best in partial shade as planters in Florida learned by growing it under slatted sheds. That is not practicable in Porto Rico. Live shade has been tried but it has not proved to be practicable.

GROWTH AND DEVELOPMENT OF THE PLANT. - The slip, sucker or crown is an entire plant in miniature. It consists of a central stem, which will be termed "stalk" in these articles, upon which the leaves are arranged in a whorl, the base of one overlapping that of another. As the stem enlarges new leaves are formed from the center of the apex until at a certain stage the fruit-stem is formed instead of leaves. The flowerhead on the apex of that stem is formed simultaneously with it and as the stem elongates the flowerhead also expands. The growth at this stage is very rapid and with the elongation of the stem the flowerhead is soon carried well above the central leaves after which the growth is confined to fruit formation and towards maturity to slip formation as well.

The materials from which the fruit and slips are formed are products manufactured in the leaves and it may be helpful to compare the leaf with a factory in which the individual cells are manufacturing units. Each cell contains minute cells, called plastids, which are filled with chlorophyll, the green coloring matter of the leaf. These correspond to the cylinders of the engine that drives the machinery in the factory. They are being oiled and constantly repaired, so to speak, by the manufactured products together with the inorganic matter brought up from the soil. The carbon dioxide absorbed by the cell, in gaseous form, from the surrounding atmosphere, corresponds to the gasoline and the sunlight to the electric spark of the gasoline engine. In the engine the spark induces the change from liquid gasoline to a gaseous form. In the plant the light energy, acting upon the chlorophyll, results in the formation of sugar from the carbon, in the carbon dioxide, which combines with hydrogen and oxygen absorbed from the soil in the form of water. The process, which is called photosynthesis, is brought about by processes which it is difficult to follow with the technique that has so far been developed. Products, called enzymes, seem to be involved and a measure of these is helpful in explaining why certain reactions do or do not take place.

In the mechanical factory the energy produced by the explosion of the gasoline serves to rotate an axle from which the power is transferred to the various working units, step by step, by means of gears and pulleys. In the plant the products are likewise transferred to other parts, step by step. The first product is sugar, which is soluble in the cell sap. But as experience teaches, there is a limit to the amount of sugar that can be dissolved in a given amount of water. Therefore, if the sugar manufactured in the cells remained there, or in the sap surrounding

the cells, the solution would soon be so concentrated that further action would automatically cease. It is conceivable that a plant might be so constructed as to allow a transference of sugar, from the place of origin, as fast as made and that seems actually to be the case with some plants, but most plants are not so constructed. The first step is a change of sugar into starch which is insoluble in the cell sap. This change, taking place as it does in the normal loaf, allows for continued activity of the chloroplasts. If, however, the starch formation is impeded, as it is in leaves under certain abnormal conditions, the sugar solution may become too saturated, resulting in a stoppage of the machinery.

Starch, being insoluble, cannot move as such, therefore it is changed into sugar and as a sugar solution it is transferred to places where it is needed for tissue building. What is not needed for that purpose goes to the stalk where it is again changed into starch. This takes place, in the plant, principally at night when photosynthesis, that is sugar formation, stops. As in a leaf where the change of sugar to starch is impeded so also it is conceivable that the change from starch to sugar may be delayed or stopped. When that happens a congestion will naturally take place and the machinery stops.

The changes from sugar to starch or vice versa may be brought about by enzymes in the laboratory, and as these enzymes are present in the plant it is reasonable to suppose that they play a similar role there. Therefore when anything happens to a plant by which the formation of one or more of the necessary enzymes is impeded or its action is suppressed the balance will be upset and perhaps the usual functions will entirely cease.

The starch stored in the stalk is the principal source of the material entering into the fruit. That is proved by the following example, which is familiar to all pineapple growers. A sucker that is planted after it has attained the size of an average bearing plant will bloom and fruit shortly after. The fruit will, however, be much below normal size regardless of how well the plant may be fertilized. This shows that the leaves are not capable of manufacturing sugar as fast as it is required by the fruit. Hence the necessity of a large plant-stalk.

FRUIT FORMATION. - As fruit formation is the ultimate object of pineapple growing, and as the price of fruit is governed, to a large extent, by the time of the year it can be marketed, the importance of any knowledge that will help to control fruit formation is self-evident. The very fact that a large sucker will fruit shortly after planting, as just mentioned, shows that the governing factor is not what is usually termed maturity. Or if that definition is to be retained it must be based upon an interpretation entirely separate from time. Such a definition is possible in view of the results obtained in this investigation.

CAUSES OF DIFFERENCES OBSERVED. - Two plants growing almost side by side, may show differences that cannot be attributed to soil conditions. In such cases it is usual to ascribe the differences to qualities that are said to be inherent in the plants. That factor will not be included in these articles for very little data is at hand from which conclusions can be drawn. In the experiments conducted all possible precautions were taken to guard against the inheritance factor entering in to the extent of interfering seriously with the results; and as the results are, in all cases, based upon large numbers of plants it does not actually interfere. Therefore, the differences observed can be ascribed to the soil and its content, and an attempt will be made, in these articles, to do so.

